INSTALLATION
&
OPERATING INSTRUCTIONS

FOR

ONAN ELECTRIC GENERATING PLANTS

WA

Series

7-58

D.W.ONAN & SONS INC. MINNEAPOLIS 14, MINN.

947-1

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GENERAL INFORMATION

THE PURPOSE OF THIS BOOK. This instruction book is furnished so that the operator may learn of the characteristics of the plant. A thorough study of the book will help the operator to keep the plant in good operating condition so that it will give efficient service. An understanding of the plant will also assist the operator in determing the cause of trouble if it occurs.

KEEP THIS BOOK HANDY. Such simple mistakes as the use of improper oil, improper fuel, or the neglect of routine servicing may result in failure of the plant at a time when it is urgently needed. It is suggested that this book be kept near the plant so that it may be referred to when necessary.

SERVICE. If trouble occurs and the operator is unable to determine the cause after a thorough study of this book, or if he is unable to determine what repair parts are required, needed information will be furnished upon request. WHEN ASKING FOR INFORMATION, BE SURE TO TO STATE THE MODEL, SPEC., AND SERIAL NUMBERS OF THE PLANT. THIS INFORMATION IS ABSOLUTELY NECESSARY AND MAY BE OBTAINED FROM THE NAMEPLATE ON THE PLANT.

MANUFACTURER'S WARRANTY

The Manufacturer warrants each product of its manufacture to be free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to the Manufacturer's instructions.

Manufacturer's obligation under this warranty is limited to correcting without charge at its factory any part or parts thereof which shall be returned to its factory or one of its Authorized Service Stations, transportation charges prepaid, within ninety (90) days after being put into service by the original user, and which upon examination shall disclose to the Manufacturer's satisfaction to have been originally defective. Correction of such defects by repair to, or supplying of replacements for defective parts, shall constitute fulfillment of all obligations to original user.

This warranty shall not apply to any of the Manufacturer's products which must be replaced because of normal wear, which have been subject to misuse, negligence or accident or which shall have been repaired or altered outside of the Manufacturer's factory unless authorized by the Manufacturer.

Manufacturer shall not be liable for loss, damage or expense directly or indirectly from the use of its product or from any other cause. The Manufacturer makes no warranty whatsoever with respect to component parts which are warranted separately by their respective manufacturers.

The above warranty supersedes and is in lieu of all other warranties, expressed or implied, and no person, agent or dealer is authorized to give any warranties on behalf of the Manufacturer nor to assume for the Manufacturer any other liability in connection with any of its products unless made in writing and signed by an official of the Manufacturer.

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT.

The Onan generating plant of the WA series consists of a Waukesha model 145 GZ-7-K engine which supplies the motive power, a revolving field alternating current generator with attached "static" exciter, and necessary engine and electrical controls. The electrical output characteristics vary between the various models and is noted on the Onan nameplate attached to the unit.

Each generating plant is given a complete running test and carefully checked before leaving the factory. Inspect the plant closely for any damage which may have occurred in shipment. Any such damage must be corrected before putting the plant in operation.

ENGINE

The engine is a Waukesha model 145 GZ-7-K which is described in the Waukesha operator's manual. The specific engine used may have variations due to the type of fuel used (gasoline, natural gas, etc.), type of cooling, or for other specific requirements specified by the plant purchaser.

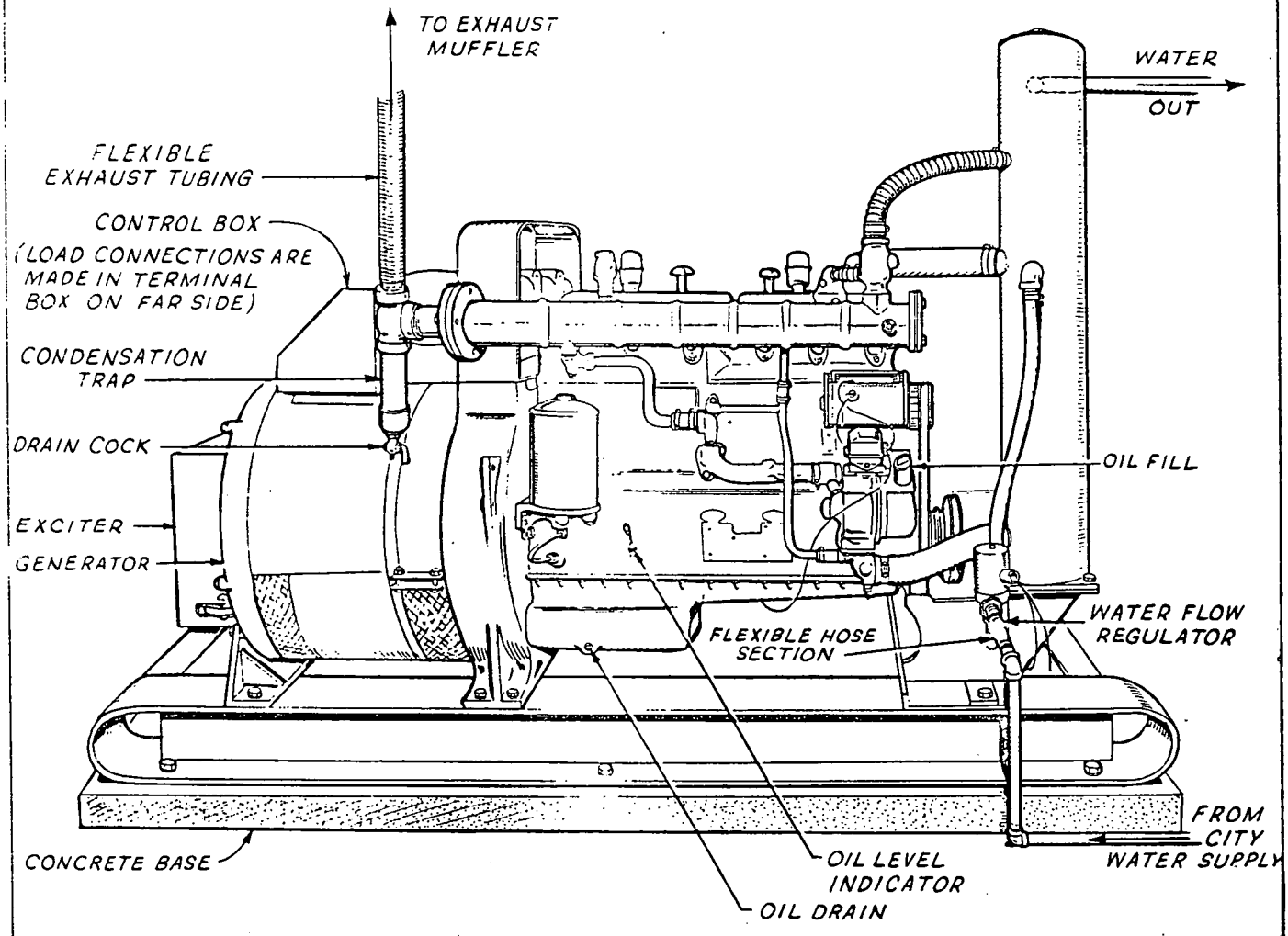
Accessories installed on the engine, safety devices, engine indicating gauges, etc. also vary according to purchaser options.

GENERATOR

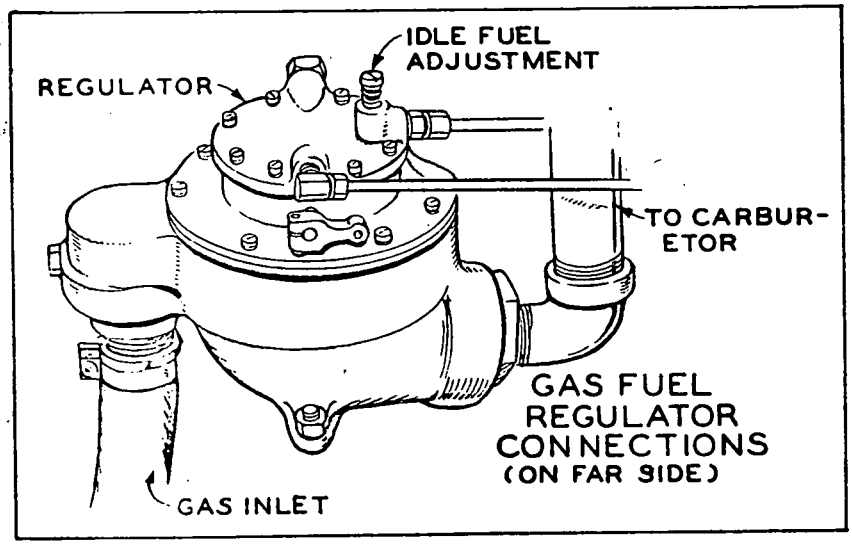
The generator alternator consists of a 4 pole revolving field type alternating current generator. The alternator stator is attached directly to the rear end of the engine. The alternator rotating field is attached to the engine flywheel, and so turns at engine speed. Thus the 60 cycle plant must operate at approximately 1800 rpm, and at approximately 1500 rpm for 50 cycle plants. The alternating current is generated in the stator winding and is fed directly to the output terminals. The rotor is supported at the engine by the engine flywheel and at the outer end by a large ball bearing fitted into the end frame. The exciter components are mounted inside a sheet metal enclosure attached to the end frame of the alternator. The design of the exciter provides for almost constant ac alternator output over a wide range of load conditions, and provides for maintaining voltage when the generator is called upon to start large electric motors.

CONTROLS

Electrical meters and controls, and engine operating gauges and controls vary according to the plant model. Refer to the wiring diagrams supplied. Electrical meters provide for checking the generator output. A running time meter provides for recording operating time of the plant. Engine gauges provide for checking engine operation.



TYPICAL INSTALLATION
CITY WATER
COOLING
NATURAL GAS FUEL



Installation of the generating plant involves its location, connection of fuel source, connection of exhaust line, starting battery installation, wiring to load, and (optional feature) connection to source of cooling water. A typical installation is shown.

LOCATION. - In the average installation, the location has been pre-selected. For standby use, an indoor location is usually required. Check local regulations regarding minimum ambient temperature. In general, the location should be reasonably dust free, warm, and dry. Aside from cooling facilities which will depend upon the type of cooling used, the location should provide for circulation of air to dissipate heat from the generator and radiant heat from the engine. Provide sufficient clearance on all sides for convenience in servicing the plant. A minimum of 24 inches is recommended.

MOUNTING. - Refer to the outline drawing No. 500A592. If desired, the plant can be mounted on raised concrete or heavy timber pedestals to provide sufficient clearance for future oil pan removal. Tie-down bolts can be used as desired.

VENTILATION. - For radiator cooled units, proper ventilation is of vital importance. A large volume of fresh cooling air must have free access to the plant. In small room installations, this may require an auxiliary fan, connected to operate any time the plant is running. The usual method of exhausting heated air is to construct a duct from the front of the radiator to an outside wall, with proper precautions in cold climates against any back-flow of cold outside air during shut down.

Note that a pusher type fan forces air out through the front of a radiator cooled plant. For forced pressure (city water, etc.) cooled units, ventilation is seldom a problem. However sufficient air movement must be available to properly cool the generator.

WATER LINES. - Units designed for pressure cooling are provided with an electrical solenoid valve which is closed during non-operating periods. Connect the water source to the manual lock valve inlet, using 3/4 inch pipe and a length of flexible hose. Inlet water pressure should allow not less than 14 gallons per minute flow when a standpipe system is used. Pipe the water outlet flow to a convenient drain, using 1-1/2 inch pipe or equivalent hose.

FUEL CONNECTION, NATURAL GAS. - Connect the gas supply line to the 2 inch pipe size inlet of the fuel regulator. The supply line should include a shut-off valve and (optional) a suitable filter. Use an approved hose or other flexible connection between the regulator inlet and the supply pipe. The gas flow regulator is intended for use with a line pressure of 7 to 10 inch water column. Refer to the engine instruction manual, and to the instructions provided with the regulator.

EXHAUST CONNECTION. - Exhaust gases from the engine are poisonous and must be piped outside. Exhaust manifolds and connections vary according to the purchaser's option. The water cooled exhaust manifold is fitted with a 3" pipe outlet. Avoid sharp elbow turns in the exhaust line. A flexible tube connection to the manifold is recommended.

INSTALLATION

The engine manufacturer recommends that restrictions to flow be as little as possible, and that back pressure be held to 1/2 pound per square inch maximum. Install a condensation trap in the line if the line runs upward. Insulate or shield the exhaust line as required.

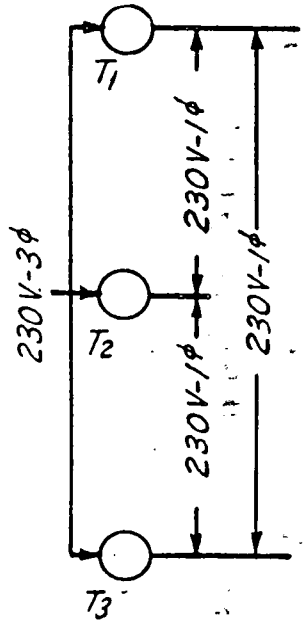
BATTERY. - As indicated on the wiring diagram, a 12 volt (or two 6 volt batteries in series) battery is required. The engine system is designed for a negative ground. Connect the cable from the starter solenoid to the battery positive post, and the grounded (negative) cable to the battery negative post.

ELECTRICAL CONNECTIONS. - The generator output terminals are large studs located at the side of the alternator. The terminal studs are marked as designated on the output control wiring diagram. The neutral terminal will be identified as T0 - T1, T2, T3 terminals are "hot".

Be sure wiring meets requirements of electrical codes in effect at the installation. Most local regulations require the wiring connections be made by a licensed electrician and that the installation be inspected and approved before operation. In all cases, a switch (either manual or automatic type) must be provided when the plant is used for standby (emergency) service. This switch must be connected so that there is no possibility for the generator current to be fed into the normal source of power lines.

Complete instructions for connecting an automatic switch (line transfer) are included with such equipment. Remote control wires are to be connected to the "remote operation" terminals marked B—, 1 and 2. B— terminal supplies 12 volt battery current for energizing the control circuit, #1 is grounded, and #2 serves as an extension for the "run-stop" toggle switch circuit.

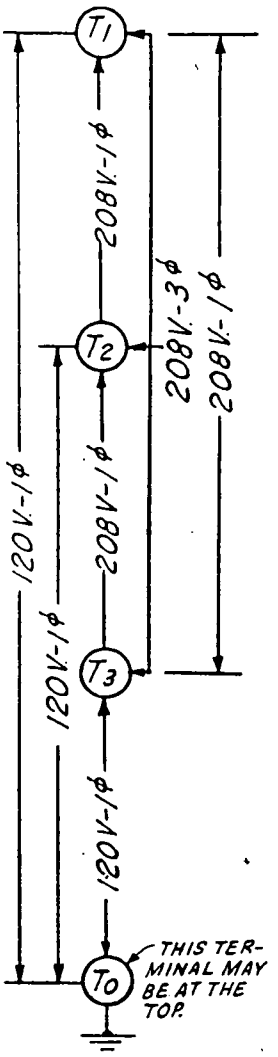
230 VOLT, 3 PHASE, 3 WIRE PLANT. - No terminal is grounded. For three phase current, connect separate load wires to each plant terminal "T1", "T2", and "T3", one wire to each terminal. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. If phase sequence is important, be sure to check the phase sequence before connections are completed.



To obtain 230 volt, single phase current, connect separate load wires to each of any two plant terminals. Three 230 volt single phase circuits are thus available, with not more than 1/3 of the plant rated capacity for each circuit. Balance the load as closely as possible among the circuits.

If both single phase and three phase current is to be used at the same time, use care not to overload any one circuit. Subtract the amount of the 3 phase load from the rated capacity of the plant. Divide the remainder by 3, and this is the maximum load that can be taken from any one circuit for single phase current use.

120/208 VOLT, 3 PHASE, 4 WIRE, WYE-CONNECTED PLANT. - The terminal marked "T0" is grounded. For 120 volt, single phase current, connect the "neutral" (white) load wire to the "T0" terminal. Connect the "hot" (black) load wire to any one of the other three terminals, "T1", "T2", "T3". Three separate 120 volt, single phase circuits are thus available. Do not attempt to take more than 1/3 the rated capacity of the plant from any one circuit. Balance the load as closely as possible between the three circuits.



For 208 volt, three phase current, connect a separate load wire to each of the plant terminals "T1", "T2", and "T3", leaving the "T0" terminal unused. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. If phase sequence is important, check the phase sequence before making final connections.

For 208 volt, single phase current, connect a separate load wire to each of any two terminals "T1", "T2", or "T3". Do not use the "T0" terminal. Three separate single phase circuits are available: "T1", and "T2", "T1" and "T3", "T2", and "T3". Do not attempt to take more than 1/3 the rated capacity of the plant from any one circuit. Balance the load as closely as possible between the three circuits.

If both single and three phase current is used at the same time, follow the principles of load distribution as given for the 3 phase, 3 wire plant.

460 VOLT OR 575 VOLT, THREE PHASE, THREE WIRE PLANT. - Follow the principles of connection as given for the 230 volt, 3 phase, 3 wire plant.

220 VOLT, SINGLE PHASE/380 VOLT, THREE PHASE, 4 WIRE PLANT. - Follow the principles of connection as given for the 120 volt, single phase/208 volt, 3 phase, 4 wire plant.

120/240 VOLT, 3 PHASE, 4 WIRE, DELTA-CONNECTED PLANT. - This type of generating plant is specially designed so that two types of loading can be applied to the generator; regular 240 volt, 3 phase, 3 wire operation; or, combination 240 volt, 3 phase, 3 wire and 120/240 volt, 1 phase, 3 wire operation.

The load terminals are marked T1, T2, T3 and T0. The T0 terminal is the generator center tap between T1, and T2. The T0 terminal of the generator is not grounded.

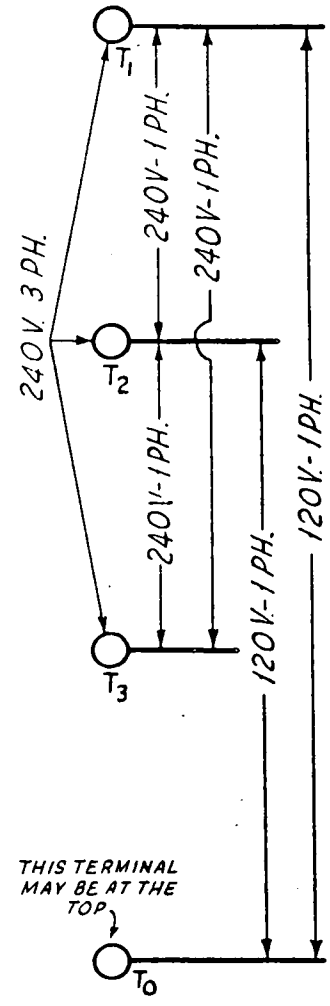
For 240 volt 3 phase 3 wire operation connect the three load wires to the three terminals T1, T2, T3, one wire to each terminal post. For 3 phase 3 wire operation the T0 terminal is not used and is normally not grounded.

If it is desired to use combination single phase and three phase loads simultaneously connect such single phase loads as follows:

For 120/240 volt, 1 phase, 3 wire operation, terminals T1 and T2 are the "hot" terminals; the T0 terminal is the neutral (which can be grounded if desired). For 120 volt service, connect the "hot" (black) load wires to the T1 and T2 terminals, and the neutral (white) wire to the T0 terminal. Two 120 volt circuits are thus obtained. The two black wires connected to T1 and T2 will give one 240 volt circuit.

Any combination of single phase and three phase loading can be applied to the generator simultaneously as specified above as long as no terminal current exceeds the rated NAMEPLATE current of the generator.

Combination single phase and three phase loads applied to a three phase generator are unbalanced loads which cause the phase voltages to be unequal. These unbalanced loads will not create voltage unbalance of the phase voltages of greater than 5 per cent so long as no terminal current exceeds the rated current of the generator.



OPERATION

PREPARATION. - Refer to the SERVICE section of the engine manual and fill the engine crankcase with oil as recommended. The capacity of the standard oil pan is 18 quarts, U.S. measure. However, an extra amount may be required for the oil filter or other accessories. On the initial run, check the oil level on stick after 10 to 15 minutes running and add oil as necessary to bring the level up to the FULL mark. Refill accordingly thereafter.

On units which use a coolant radiator, fill the radiator with clean soft water. If there is any possibility of exposure to freezing temperatures, use antifreeze solution in the proper proportion. On the initial run, check the coolant level several times, adding as necessary to compensate for any air pockets which may have been present at the original filling.

Service the air cleaners with oil as instructed on the cleaners. Be sure to properly tighten the air cleaner oil cups after servicing.

Make a complete check of the installation to be sure that all requirements have been met.

STARTING. - See that the fuel supply is turned on. Throw the control panel toggle switch to its RUN position. The plant will crank and start running. For the initial run, see that the panel circuit breaker is at its OFF position. Check the engine operation before throwing the circuit breaker to its ON position.

If the engine fails to start, the cranking limiter will automatically stop cranking. After determining the cause for failure to start, push the reset button in (wait at least one minute) and repeat the starting.

OPERATION. - After the initial start, allow the engine to warm up, observing indicating gauges for proper operation. Connect electrical load and check for proper voltage, etc. A sustained overload will cause the panel circuit breaker to trip, disconnecting all load. Investigate and correct the cause before resetting the circuit breaker.

Some slight readjustment of the carburetor may be required. The plant was test run on natural gas of 1000 BTU rating. Refer to the engine manual.

COOLANT WATER FLOW. - On units equipped for "city water" pressure cooling, adjust the rate of water flow. At the point of water line connections, immediately below the water inlet solenoid valve, an adjustable valve with separate key is provided. Adjust the valve to provide a flow of water sufficient to keep the water temperature gauge in the proper operating range. Excessive water flow is wasteful and expensive - too little flow will cause a rise in temperature and automatic shut-down by the high temperature switch. To avoid unauthorized tampering after proper adjustment, remove and store the valve adjusting key.

STOPPING. - To stop the plant, throw the panel toggle switch to its "STOP-AUTO" position. If an extension control circuit used, similar action must be followed.

OPERATION

ENGINE CONTROLS. - The functions of the engine indicating instruments are self evident. Normal oil pressure after warm up is approximately 40 lbs. water temperature 160 to 180 degrees.

Several safety devices are standard equipment. These devices operate to stop the engine in case of certain improper operation. A low oil pressure switch operates if the oil pressure should fail. A high water temperature switch operates if the coolant temperature rises too high. This switch has an adjusting dial and must never be set above the boiling point of the coolant. An over-speed switch operates if the engine speed rises dangerously high. If one of the safety switches operates to stop the engine, the panel RESET button must be pushed to reset the emergency stop relay before the unit can be restarted.

An optional circuit for installation of a warning light or audible alarm is shown on the wiring diagram. This circuit is energized when one of the safety circuits operates.

PERIODIC OPERATION. - An engine which is left standing unused for extended periods usually becomes increasingly difficult to start. When used for standby service, the plant should be "exercised" regularly.

WARNING

AN OVER SPEED PROTECTIVE SWITCH IS BUILT INTO THE OUTER END OF THE GENERATOR ROTOR SHAFT. THIS OVERSPEED DEVICE AUTOMATICALLY SHUTS OFF THE ENGINE IF THE SPEED REACHES 2100 RPM. UNDER NO CIRCUMSTANCES SHOULD THE OVER SPEED SWITCH BE BY-PASSED OR SET FOR A HIGHER CUT OFF SPEED. EXTENSIVE GENERATOR DAMAGE WILL RESULT FROM SUCH OVER SPEED.

PERIODIC SERVICE

ENGINE. - Refer to the SERVICE section of the WAUKESHA engine operator's manual. A running time meter on the control panel indicates the total number of hours the plant has run. Refer to the meter and keep a record chart to assure servicing at proper intervals.

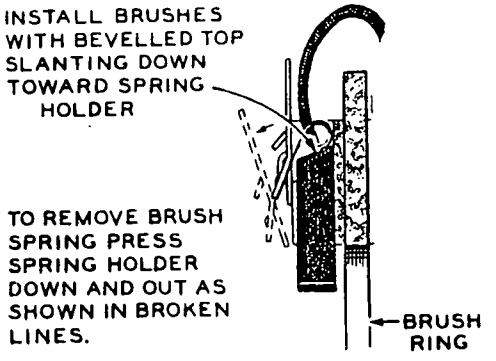
In addition to the actual service operations, always thoroughly inspect the plant for oil or water leaks, loose electrical connections, loose or damaged accessories, etc. Make any necessary repairs.

GENERATOR. - Each 200 hours of operation, check the slip rings and brushes. In service, the slip ring contact surfaces acquire a glossy brown color, which is normal. Do not attempt to maintain a bright, newly machined appearance. Heavy coating of the contact surface can usually be cleaned off with lint free cloth or light canvas. Slight roughness can be remedied by lightly sanding with #00 sandpaper.

Check the condition of the brushes and springs. If brushes wear so that the top of the brush is below a point midway between the outer and inner end of its guide, replace with new brushes. Do not use a substitute brush that may look the same but may have different electrical characteristics. Be sure the brush is inserted so that the short side of the taper is toward the spring and its bracket. Never bend the spring back over the edge of its bracket- doing so will put a kink in it and require replacement.

The generator bearing is prelubricated and sealed. It requires no servicing.

Occasionaly clean the generator exciter, using moderately compressed air to blow out dust, etc. Inspect for tight connections and secure mounting of components.



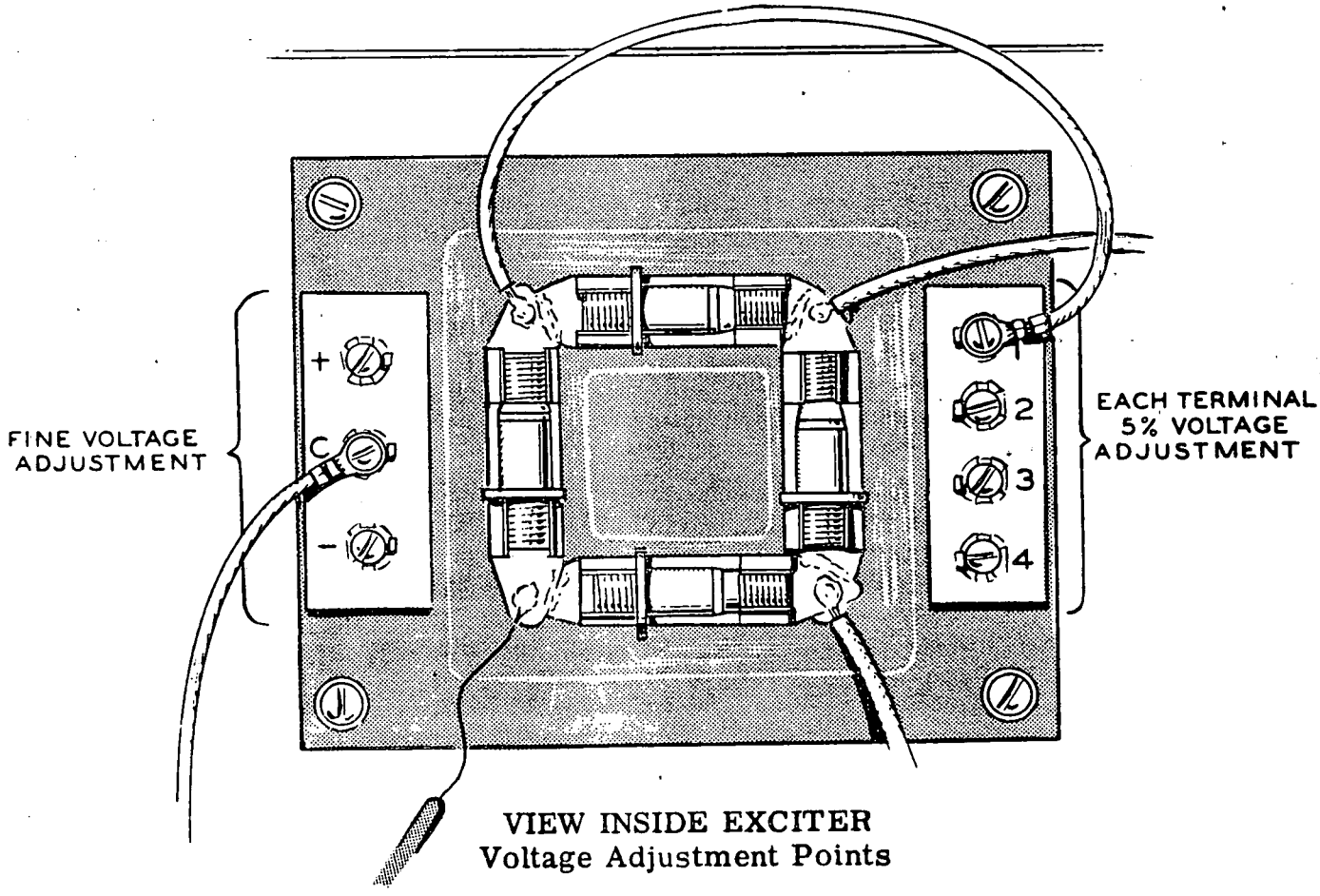
BRUSH SPRING REMOVAL

ADJUSTMENTS

GOVERNOR. - The engine governor operation and adjustment are covered in the Waukesha engine manual. The governor was adjusted during the factory test run, to keep the engine speed at approximately 1800 rpm. Each 30 rpm variation in engine speed causes a 1 cycle change in the generator output frequency, and will be indicated on the control panel frequency meter.

Ordinarily, no change in the governor or vacuum compensator is required. Minor changes in speed (generator frequency) may be necessary due to local conditions of fuel, etc. Turn the vacuum compensator control knob as necessary to raise or lower the generator output frequency. The governor should control the frequency within 3 cycles, between no load and full load conditions. For example, if the frequency is 61 cycles at no load, the frequency at full load condition should be not less than 58 cycles.

VOLTAGE. - Ordinarily, if the governor is properly adjusted, the output voltage will be correct. The exciter was connected for rated output during the factory test run. However if it becomes necessary to change or adjust the output voltage, change connections in the exciter as follows. Refer to the illustration.



VIEW INSIDE EXCITER
Voltage Adjustment Points

1. Be sure the governor is properly adjusted, for correct current frequency.

2. Stop the plant before making any voltage adjustment.

3. Note that one lead is connected to a small terminal block marked +, C, and —. By moving the lead connection from the "C" terminal to the + terminal, output voltage will be raised approximately 3%. Moving to the — terminal will lower the output voltage by approximately 3%.

4. If a greater voltage adjustment is necessary, a second lead is connected to a terminal block marked 1, 2, 3 and 4. Moving the lead to an adjacent terminal (from 2 to 3, 1 to 2, etc.) changes the output voltage by approximately 5%. After making such a change, start the plant and again check the output voltage. It may be necessary to readjust the "fine" voltage adjusting lead as described in step 3.

REPAIR PARTS

REFER TO THE WIRING DIAGRAM FOR CONTROL REPAIR PARTS. FOR ENGINE OR GENERATOR REPAIR PARTS, A LIST OF PARTS WILL BE AVAILABLE UPON REQUEST. PLEASE FURNISH THE COMPLETE MODEL AND SERIAL NUMBER AS SHOWN ON THE ONAN NAMEPLATE WHEN REQUESTING PARTS OR SERVICE INFORMATION.